

**RatioWorks™ BCFL, SE**

 Catalog number: 21191  
 Unit size: 1 mg

Component	Storage	Amount
RatioWorks™ BCFL, SE	Freeze (< -15 °C), Minimize light exposure	1 vial (1 mg)

**OVERVIEW**

Intracellular pH plays an important modulating role in many cellular events, including cell growth, calcium regulation, enzymatic activity, receptor-mediated signal transduction, ion transport, endocytosis, chemotaxis, cell adhesion and other cellular processes. pH-sensitive fluorescent dyes have been widely applied to monitor changes in intracellular pH in recent years. Imaging techniques that use fluorescent pH indicators also allow researchers to investigate these processes with much greater spatial resolution and sampling density that can be achieved using other technologies such as microelectrode. Among them, 2',7'-bis-(2-carboxyethyl)-5-(and-6)-carboxyfluorescein (BCECF) is the most popular pH probe since it can be used to monitor cellular pH ratiometrically. However, all the commercial BCECF AM is a complex mixture of at least three isomers with different ratios from batch to batch, complicating the BCECF applications. BCFL is developed to overcome this isomer difficulty associated with BCECF AM. As BCECF, BCFL exhibits a pH-dependent dual excitation, essentially identical to BCECF. It has pKa of ~7.0, identical to BCECF too. As with BCECF, the dual excitation spectrum of BCFL with an isosbestic point at 454 nm should make BCFL a good excitation-ratiometric pH indicator. BCFL ratiometric imaging makes intracellular pH determination essentially independent of several variable factors, including dye concentration, path length, cellular leakage and photobleaching rate. BCFL, AM is a single isomer, making the pH measurement much more reproducible than the BCECF, AM, which is consisted of quite a few different isomers. This amino-reactive BCFL derivative can be used for preparing BCFL conjugates as ratiometric fluorescent probes.

**PREPARATION OF STOCK SOLUTIONS**

*Unless otherwise noted, all unused stock solutions should be divided into single-use aliquots and stored at -20 °C after preparation. Avoid repeated freeze-thaw cycles.*

**1. Protein stock solution (Solution A)**

Mix 100 µL of a reaction buffer (e.g., 1 M sodium carbonate solution or 1 M phosphate buffer with pH ~9.0) with 900 µL of the target protein solution (e.g. antibody, protein concentration >2 mg/mL if possible) to give 1 mL protein labeling stock solution. **Note:** The pH of the protein solution (Solution A) should be 8.5 ± 0.5. If the pH of the protein solution is lower than 8.0, adjust the pH to the range of 8.0-9.0 using 1 M sodium bicarbonate solution or 1 M pH 9.0 phosphate buffer. **Note:** The protein should be dissolved in 1X phosphate buffered saline (PBS), pH 7.2-7.4. If the protein is dissolved in Tris or glycine buffer, it must be dialyzed against 1X PBS, pH 7.2-7.4, to remove free amines or ammonium salts (such as ammonium sulfate and ammonium acetate) that are widely used for protein precipitation. **Note:** Impure antibodies or antibodies stabilized with bovine serum albumin (BSA) or gelatin will not be labeled well. The presence of sodium azide or thimerosal might also interfere with the conjugation reaction. Sodium azide or thimerosal can be removed by dialysis or spin column for optimal labeling results. **Note:** The conjugation efficiency is significantly reduced if the protein concentration is less than 2 mg/mL. For optimal labeling efficiency the final protein concentration range of 2-10 mg/mL is recommended.

**2. RatioWorks™ BCFL, SE stock solution (Solution B)**

Add anhydrous DMSO into the vial of RatioWorks™ BCFL, SE to make a 10 mM stock solution. Mix well by pipetting or vortex. **Note:** Prepare the dye stock solution (Solution B) before starting the conjugation. Use promptly. Extended storage of the dye stock solution may reduce the dye activity. Solution B can be stored in freezer for two weeks when kept from light and moisture. Avoid freeze-thaw cycles.

**SAMPLE EXPERIMENTAL PROTOCOL**

This labeling protocol was developed for the conjugate of Goat anti-mouse IgG with RatioWorks™ BCFL, SE. You might need further optimization for your particular proteins. **Note:** Each protein requires distinct dye/protein ratio, which also depends on the properties of dyes. Over labeling of a protein could detrimentally affects its binding affinity while the protein conjugates of low dye/protein ratio gives reduced sensitivity.

**Run conjugation reaction**

1. Use 10:1 molar ratio of Solution B (dye)/Solution A (protein) as the starting point: Add 5 µL of the dye stock solution (Solution B, assuming the dye stock solution is 10 mM) into the vial of the protein solution (95 µL of Solution A) with effective shaking. The concentration of the protein is ~0.05 mM assuming the protein concentration is 10 mg/mL and the molecular weight of the protein is ~200KD. **Note:** We recommend to use 10:1 molar ratio of Solution B (dye)/Solution A (protein). If it is too less or too high, determine the optimal dye/protein ratio at 5:1, 15:1 and 20:1 respectively.
2. Continue to rotate or shake the reaction mixture at room temperature for 30-60 minutes.

**Purify the conjugation**

The following protocol is an example of dye-protein conjugate purification by using a Sephadex G-25 column.

1. Prepare Sephadex G-25 column according to the manufacture instruction.
2. Load the reaction mixture (From "Run conjugation reaction") to the top of the Sephadex G-25 column.
3. Add PBS (pH 7.2-7.4) as soon as the sample runs just below the top resin surface.
4. Add more PBS (pH 7.2-7.4) to the desired sample to complete the column purification. Combine the fractions that contain the desired dye-protein conjugate. **Note:** For immediate use, the dye-protein conjugate need be diluted with staining buffer, and aliquoted for multiple uses. **Note:** For longer term storage, dye-protein conjugate solution need be concentrated or freeze dried.

**EXAMPLE DATA ANALYSIS AND FIGURES**
**Characterize the Desired Dye-Protein Conjugate**

The Degree of Substitution (DOS) is the most important factor for characterizing dye-labeled protein. Proteins of lower DOS usually have weaker fluorescence intensity, but proteins of higher DOS (e.g. DOS > 6) tend to have reduced fluorescence too. The optimal DOS for most antibodies is recommended between 2 and 10 depending on the properties of dye and protein. For effective labeling, the degree of substitution should be controlled to have 6-8 moles of RatioWorks™ BCFL, SE to one mole of antibody. The following steps are used to determine the DOS of RatioWorks™ BCFL, SE labeled proteins.

**Measure absorption**

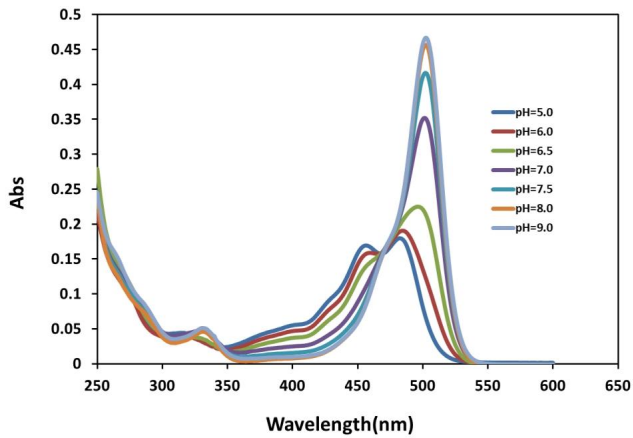
To measure the absorption spectrum of a dye-protein conjugate, it is recommended to keep the sample concentration in the range of 1-10 µM depending on the extinction coefficient of the dye.

**Read OD (absorbance) at 280 nm and dye maximum absorption ( $\lambda_{max}$  = 504 nm for RatioWorks™ BCFL, SE dyes)**

For most spectrophotometers, the sample (from the column fractions) need be diluted with de-ionized water so that the OD values are in the range of 0.1 to 0.9. The O.D. (absorbance) at 280 nm is the maximum absorption of protein while 504 nm is the maximum absorption of RatioWorks™ BCFL, SE. To obtain accurate DOS, make sure that the conjugate is free of the non-conjugated dye.

**Calculate DOS**

You can calculate DOS using our tool by following this link:  
<https://www.aatbio.com/tools/degree-of-labeling-calculator>



**Figure 1.** The pH dependent absorbance spectra of BCFL Acid.

**DISCLAIMER**

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